STATEMENT OF BASIS
(for Proposed Permit Limits (New Permit))

PERMITTEE:	River Rock County Water and Sewer District
PERMIT NUMBER:	MTX000147
RECEIVING WATERS:	Class I Ground Water
FACILITY NAME:	River Rock Subdivision 240 N. River Rock Road Belgrade, MT 59714
SOURCE LOCATION:	SW 1/4 Section 3, Township 1 South, Range 4 East, Gallatin County (Attachment 1)
CONTACT:	Sharold Buerkle, President, River Rock County Water and Sewer District
TELEPHONE:	(406)388-0613
FEE INFORMATION	
Type:	Ground Water, domestic wastes
Number of Outfalls:	1
Outfall Type:	Infiltration Percolation Beds

I. PERMIT STATUS

The owner of the wastewater system has a requirement to maintain an area that is large enough for spray irrigation of the treated wastewater generated by this development in case the existing treatment system does not operate properly. This requirement was in accordance with the agreement between the original owner of the facility (Wallace Diteman) and the Department (formerly Department of Health and Environmental Sciences) on August 28, 1978. To have the requirement to maintain undeveloped land available for spray irrigation removed from the subdivision approval, the system owner has agreed to apply for and meet the requirements of a ground water discharge permit. The permittee submitted their initial MGWPCS permit application on October 6, 2003. On March 5, 2004 the Department requested that the application fee and first years annual fee be submitted. On April 8, 2004 the Department received the appropriate fees. The application was deemed substantially complete on May 19, 2004.

The wastewater treatment system received plan and specification approval from the Department on October 19, 1999 (EQ #99-2750). The system construction was completed in 1999.

The community wastewater treatment system will serve 1,192 single-family homes, a school and some retail commercial businesses. The system will be used to treat residential strength (domestic) wastewater.

The IP cells are constructed on top of quaternary alluvial deposits of the Gallatin valley. Based on two monitoring wells (MW-1 and MW-2) constructed along the north end of the lagoon cells and IP beds, the soils consist of sandy gravels and gravelly sands down to the water table at 50 to 56 feet below ground surface (see Attachment 2a).

With the issuance of a ground water discharge permit, the requirement for potential land application of treated effluent will be removed from the subdivision approval and therefore the permit will not include an outfall for land application.

The wastewater will be transported to the treatment system via gravity-flow and lift stations. The wastewater will receive treatment in two aerated lagoons in series. During the summer months, after treatment in the lagoons, the wastewater will be diverted to a third lagoon cell prior to final disposal in one of seven infiltration-percolation (IP) beds. During the winter months, lagoon cell #3 will be used as an additional IP cell (see Attachment 2b). The design flow rate for the treatment system is 374,000 gallons per day (gpd).

The permittee has requested a standard mixing zone for nitrate and fecal coliform bacteria.

III. DESCRIPTION OF DISCHARGE

A. Outfall Location

The permit authorizes the permittee to discharge treated domestic wastewater from IP beds and lagoon cell #3 (Outfall 001) to ground water.

Outfall 001 is located at 45°46’44’’ North latitude (45.7790) and 111°13’24’’ West longitude (–111.2234).

B. Past Monitoring Data / Effluent Characteristics

1. Past Monitoring Data

The wastewater treatment system was constructed in 1999. Between 1999 and January 2003 eleven influent and effluent wastewater samples were collected for analysis. The results for some of the parameters monitored are summarized in Table 1.

Table 1. Wastewater Influent and Effluent Monitoring Data for River Rock Wastewater Treatment System

Date	Influent/ Effluent Total Nitrogen (mg/L)	Influent/ Effluent Fecal Coliform (org./100 ml))	Influent/ Effluent Biological Oxygen Demand (BOD) (mg//L))	Influent/ Effluent Total Suspended Solids (TSS) (mg/L)	Influent/ Effluent Ortho-Phosphate (mg/L)
11/18/99[1]	3.65 / 0.85	8.0E+3 / 2.0E+0	3 / 4.5	15 / 4	<0.05 / <0.05
01/05/00[1]	2.25 / NS	1.2E+3 / NS	7.5 / NS	14 / NS	0.3 / NS
02/22/00[1]	NS / 3.25	NS / 3.0E+2	NS / 10.5	NS / 18	NS / 0.6
8/24/00	51.6 / 1.2	5.0E+7 / 9.0E+0	375 / 16.5	280 / 14	8 / <0.5
10/20/00	60.4 / 1.5	2.0E+7 / 2.2E+1	270 / 18	290 / 17	5.6 / 1.46
11/22/00	41 / 0.8	4.0E+7 / 3.6E+3	285 / 13.5	15 / 4	5 / 2.2
1/5/01	47.8 / 7.9	4.0E+6 / 1.0E+1	360 / 19.5	230 / 21	9 / 2
2/27/01	43.4 / 11.8	1.0E+9 / 8.0E+1	390 / 9	210 / 32	4.5 / 1.5
5/2201	57.8 / 7.6	1.9E+6 / 5.0E+0	225 / 27	158 / 28	16 / 2.5
6/29/01	37.1 / 6.5	4.0E+4 / 2.0E+1	330 / 28.5	140 / 24	15 / 9
11/7/02	48.3 / 17.6	3.0E+7 / 4.2E+5	240 / 22.1	225 / 24	20.4 / 4.2
1/20/03	44 / 21.6	NS / NS	240 / 36	220 / 26	18.5 / 13.5

(1) Data for these dates is not representative of the typical raw wastewater or treated wastewater due to low flows into the treatment system.

The total nitrogen, ortho-phosphate and BOD data show increasing effluent concentrations over time. These trends are likely related to the build-out of the river rock development. As the total number of homes contributing wastewater to the treatment system increased between 1999 and 2003, the retention time in the treatment system decreased which increased the effluent concentrations of total nitrogen and BOD. As the development nears build-out and the actual wastewater flows approach the design rate, the effluent concentrations should stabilize.

2. Effluent Characteristics

Using discharge monitoring data from three other wastewater treatment systems (the towns of Superior, Gardiner and Belt) that use similar treatment technology as used at the river rock facility, the average and 90th percentile effluent concentrations for total nitrogen, BOD, TSS, and total phosphorus produced by those facilities over the past three years (2002 through 2004) are listed in Table 2.

Table 2. Wastewater Effluent Statistics for Similar Wastewater Treatment Facilities (2002-2004)

Facility	Total Nitrogen (mg/L)	Biological Oxygen Demand (mg/L)	Total Suspended Solids (mg/L)	Total Phosphorus (mg/L)
GARDINER				
Average	21.0	15.4	22.1	4.1
90^{th} Percentile	28	26.4	58.8	5.4
SUPERIOR				
Average	22.8	18.6	20.3	5.8
90^{th} Percentile	34.1	31.8	53	5.3
BELT				
Average	10.0[1]	16.0	25.3	2.4[1]
90^{th} Percentile	15.9[1]	28.4	46.2	2.9[1]

(1) These values based only on one year of data (2002).

The results indicate that each system produces similar effluent quality, except for the nutrients in the Belt effluent. The total nitrogen and total phosphorus effluent concentrations are noticeably lower in the Belt wastewater than the other two facilities. Whether this difference is due to better treatment efficiencies or different influent wastewater characteristics cannot be determined from the existing data.

The 90^{th} percentile statistic is included in Table 2 to demonstrate the type of effluent concentrations that can be expected on a regular basis for these types of treatment systems.

IV. RECEIVING WATER

A. Water Use Classifications and Applicable Water Quality Standards

The facility has been collecting background ground water quality data from a monitoring well located in the southwest corner of the river rock development (MW-3). MW-3 was constructed as a background ground water quality monitoring point for comparison to two wells (MW-1 and MW-2) that are located north (downgradient) of the wastewater treatment facility (see attachment 2a). Between March 1999 and December 2004, ground water from MW-1, MW-2 and MW-3 were collected and analyzed for several water quality parameters on 18 different dates (see attachment 3).

Based on the 18 water quality analyses from MW-3, the average nitrate+nitrite (as N) of the ground water is 3.22 mg/L. However, prior to May 2002, the highest nitrate+nitrite (as N) concentration in MW-3 did not exceed 3.7 mg/L and the average of those first ten samples was only 1.77 mg/L. Since May 2002, the average nitrate+nitrite (as N) concentration from eight sampling events has been 5.05 mg/L, and has been as high as 7.0 mg/L. The cause of the increase is not certain, but may be related to historic manure storage/distribution practices or agricultural practices on the land located to the south (upgradient) from MW-3. The chloride concentration in MW-3 has not risen concurrently with the nitrate+nitrite concentrations (the chloride concentrations have remained below 11 mg/L), which indicates the nitrate+nitrite increase is likely not due to human-derived wastewater. Domestic wastewater typically includes elevated concentrations of chloride that are not typically present in agriculturally-related sources or in manure sources.

The nitrate+nitrite concentrations in the two monitoring wells (MW-1 and MW-2) directly north of the wastewater system have also shown increases. However, MW-1 and MW-2 have also shown concurrent increases in their chloride concentrations (from less than 10 mg/L to as high as 85 mg/L), which is an indication that the increasing nitrate+nitrite concentrations in MW-1 and MW-2 are likely related to the wastewater discharge.

A nitrate+nitrite (as N) concentration of 10.0 mg/L was recorded in MW-2 in September 2003. According to the Certificate of Subdivision Plat Approval for River Rock (EQ#99-2750), an increase of the nitrate+nitrite(as N) concentration in MW–1 or MW-2 above 7.5 mg/L requires the monitoring frequency for MW-1 and MW-2 to be increased from semi-annually to quarterly. However, in violation of the certificate of subdivision plat approval, no samples were collected or analyzed from MW-1 or MW-2 for 13 months after the September 2003 monitoring event.

Based on the fifteen water quality analyses from MW-3, the average specific conductivity of the ground water is 437 umhos/cm. Therefore, the classification of the receiving ground water is Class I.

The receiving water for Outfall 001 is Class I ground water as defined by the Administrative Rules of Montana [ARM 17.30.1006 (1)(a)]. Class I ground water is suitable for the following beneficial uses with little or no treatment: public and private water supplies, culinary and food processing purposes, irrigation, drinking water for livestock and wildlife and for industrial and commercial uses. Secondary and human health standards (DEQ-7, February 2006) apply to concentrations of substances in Class I ground waters (water with specific conductance equal to or less than 1,000 microSiemens/cm). Class I ground waters are considered high quality waters and are subject to Montana's Nondegradation Policy [75-5-303, Montana Code Annotated (MCA)]. The applicable water quality standards are shown in Table 3.

Table 3. Applicable Water Quality Standards

Parameter	DEQ-7 Numeric Human Health Ground Water Standards
Nitrate (as N), mg/L	10(1)
Total Phosphorus, mg/L	No numeric standard
Fecal Coliform Bacteria, organisms/100 ml	<1(2)

(1) Instantaneous maximum, no single sample shall exceed this value, DEQ-7 (February, 2006).
(2) Maximum based on 24-hour geometric mean, DEQ-7 (February, 2006).

The nearest downgradient surface water from the outfall is Ben Hart Creek. In the direction of ground water flow (N29^{o}E) Ben Hart Creek is approximately 25,400 feet from the northeast corner of the IP beds. Ben Hart Creek is classified as a B-2 surface water [ARM 17.30.610(1)].

B. <u>Mixing Zone</u>

The permittee has proposed to discharge all wastewater from Outfall 001 and has requested a standard ground water mixing zone for nitrate and fecal coliform bacteria of 500 feet. The permittee has also requested that the width of the mixing zone be increased for the cold weather season (from a width of 470 feet to a width of 660 feet in the cold weather season). The "cold weather mixing zone" is wider and accounts for discharges from lagoon cell #3 that may be used as an IP bed during the cold months. At the time that this treatment system was originally designed and approved by the state (1970's), storage cells did not have maximum allowable leakage rates, therefore lagoon cell #3 can be used as a discharge location and can also be used as a storage cell when the inflow to the cell #3 exceeds the discharge rate. Due to the difficulty in assigning multiple effluent limits over a 90-day averaging period depending on whether lagoon cell #3 is used as an IP bed or not and for how long over that 90-day period it is used, it is not feasible to assign multiple effluent limits or designate different mixing zone dimensions for different seasons. Therefore, the granted mixing zone will be based on the wider cold weather discharge. To insure there are no exceedences of water quality standards at the end of the mixing zone, the more conservative scenario between warm-weather discharges (when cell #3 is not used for discharge of treated wastewater) and cold-weather discharges (when cell #3 is used for discharge of treated wastewater) will be used in determining water quality-based effluent limits.

The permittee must comply with the ground water mixing zone rules pursuant to ARM 17.30 Subchapter 5. The Department is granting the standard ground water mixing zone extending 500 feet (ARM 17.30.517) downgradient of the IP beds and lagoon cell #3 in a N29^{o}E direction (parallel to the local ground water gradient). The hydraulic gradient is based on an average of eleven quarterly water level monitoring events on wells MW-1, MW-2 and MW-3 between June 2000 and January 2003. The shape of the mixing zone is determined from the dimensions of the IP beds/lagoon cell #3 and the measured ground water flow direction. The ground water mixing zone is granted for nitrate. <u>A mixing zone is not granted for fecal coliform bacteria because: 1) the bacteria should be adequately treated in the treatment system and in the 50 feet of unsaturated soils beneath Outfall 001; 2) the high hydraulic conductivity in the aquifer will not provide significant treatment of bacteria; and 3) the potential for additional high density development in the area downgradient of Outfall 001.</u>

<u>Most of the 500 foot ground water mixing zone extends beyond the permittees property boundary (the property boundary is less than 50 feet downgradient from Outfall 001). Due to potential access problems, installation of ground water monitoring wells may not be possible at the end of the mixing zone. If monitoring wells cannot be constructed at the end of the mixing zone, then ground water limits in the permit will need to be measured at a monitoring well (existing well MW-2) inside the mixing zone.</u>

The permittee has demonstrated that the zone of influence (assumed to be 100 feet) of any existing drinking water supply well does not intercept the mixing zone.

V. PROPOSED TECHNOLOGY-BASED EFFLUENT LIMITS

A. BOD_5 and TSS

Effluent monitoring for five-day biological oxygen demand (BOD_5) and total suspended solids (TSS) will be required to ensure the operation efficiency of the system. Technology-based effluent limits (TBELs) for BOD_5 and TSS are derived from national secondary treatment standards [40 CFR 133(a) and 40 CFR 133(b), respectively], and are listed in Table 4.

B. pH

The limits for pH are in Table 4.

Table 4. Secondary Treatment Limitations for Outfall 001

Parameter	Concentration (1) (mg/l)		Load (lb/ day)	Rationale
	7-Day Average	30-Day Average	30-Day Average(2)	
BOD_5 (mg/l)	45	30	93.6	40 CFR 133.102(a)
TSS(mg/l)	45	30	93.6	40 CFR 133.102(b)
pH (s.u.)	6.0 – 9.0			40 CFR 133.102(c)
Percent Removal (3)	85% BOD_5 and TSS			40 CFR 133.102(a) (b)

(1) See the definitions in Part I.A of the permit for explanation of terms.
(2) Calculations based on the 30-day average values of flow and concentration
(3) The arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15% of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (85% removal).

Calculations for the mass-based loadings utilized the following equation:

(lbs/day) = Design flow (mgd) x Average Concentration (mg/l) x 8.34 factor

TSS and BOD_5 (lb/day) = (0.374)(30.0)(8.34) = 93.6 lb/day (30-day)

B. Total Nitrogen

The total nitrogen (the sum of nitrate, nitrite, ammonia and organic nitrogen) concentration in typical residential wastewater ranges from 40-100 mg/L (EPA, 2002).

The wastewater treatment system has been in operation since 1999. Based on nine samples collected from the system between August 2000 and January 2003, the average influent total nitrogen (TN) concentration is 47.9 mg/L (see Attachment 4A). In that same time period, the effluent TN concentration has averaged 8.5 mg/L, but has steadily increased from a low of 0.8 to high of 21.6 mg/L (see Attachment 4B). The steady increase of the effluent TN concentrations is likely related to the under-utilization of the wastewater system as the river rock development has grown. With under-utilization, the wastewater has a longer retention time in the aerated lagoons which provides additional treatment of the nitrogen. The most recently measured concentration of 21.6 mg/L was measured when the river rock development was at approximately 67% of full build-out (January 2003). As build-out nears 100%, the effluent nitrogen concentrations should increase and then stabilize. The permittee estimates that the treatment facility will be able to reduce the influent TN concentration by 40% during the warm-weather months (approximately May through October), and only 25% during the cold-weather months (approximately November through April) prior to discharge to the ground water; these values are consistent with the method of treatment provided at this facility. Based on the influent TN concentration of 47.9 mg/L, a 40% reduction would provide a TN effluent concentration of 28.7 mg/L, a 25% reduction would provide an effluent concentration of 35.9 mg/L (these values are consistent with effluent concentrations for similar wastewater systems in Table 2). These two TN effluent concentrations, 28.7 and 35.9 mg/L, will be used as TBELs.

The variation of nitrogen treatment between summer and winter months is due primarily to the decrease of microbiological activity in colder temperatures (USEPA, 2002). The town of Superior data effluent data demonstrates a distinct difference in nitrogen treatment efficiencies between the summer months and the winter months. This information supports the permittees information that nitrogen removal will be greater in the warm months as compared to the cold weather months.

From October 2000 through November 2002 the permittee conducted seven rounds of effluent monitoring for chloride and TN and concurrent monitoring of MW-1 and MW-2 (the data from MW-1 was not used in the following analysis because it did not show as consistent or long-term water quality impacts as were observed in MW-2). This monitoring was conducted to determine the amount of natural denitrification (reduction of nitrate to nitrogen gas) that is occurring beneath the IP beds. The amount of natural denitrification beneath the IP beds can then be used in calculating the water quality-based effluent limits (WQBEL). Chloride is considered a conservative element (i.e. it does not degrade in the environment). Therefore, the percent reduction of the chloride concentration between the effluent and the well (MW-2) can be solely attributed to ground water dilution. If the amount of chloride dilution is compared to the concentration reduction of TN between the effluent and MW-2, any additional percent reduction of TN (as compared to the percent reduction of chloride) can be reasonably attributed to denitrification. Based on this method, the water quality information indicated that denitrification accounted for a 16% concentration reduction of TN between the effluent monitoring point and MW-2. That 16% reduction will be accounted for in determination of the TN WQBEL (see Part VI.A. of this SOB), and is shown in Table 5.

C. Fecal Coliform Bacteria

The wastewater treatment system does not include a disinfection process. Based on previous monitoring, the treatment system typically removes over 98 percent of the fecal coliform bacteria from the raw influent wastewater, remaining treatment will occur in the unsaturated geologic materials beneath Outfall 001. An effluent limit will not be set in the permit, instead ground water monitoring in MW-2 will be used to insure that the ground water quality standard is not exceeded.

D. Phosphorus

There is no TBEL for phosphorus.

Table 5. Technology-Based Effluent Limits for Nutrients (Outfall 001)

Parameter	90-Day Average Concentration (1) (mg/L)	90-Day Average Load(1) (pounds per day)
Total Nitrogen as N(2) (May-October)	28.7	89.5(3)
Total Nitrogen as N(2) (November-April)	35.9	112(3)
Total Phosphorus	NA	NA

(1) See definitions in Part I.A of the permit.
(2) Total Nitrogen (TN) is the sum of nitrate, nitrite and total kjeldahl nitrogen (as N).
(3) This value is determined by using the 90-day average concentration limit and the design flow of outfall 001: Load (lb/d) = flow (gpd) x concentration (mg/L) x 8.34×10^{-6}.
NA Not Applicable

VI. PROPOSED WATER QUALITY-BASED EFFLUENT LIMITS

The permittee must comply with Montana Numeric Water Quality Standards included in Circular DEQ-7 (February 2006) and protection of beneficial uses [ARM 17.30.1006]. Ground water quality standards may be exceeded within a Department authorized mixing zone provided that all existing and future beneficial uses of the state waters are protected [ARM 17.30.1005]. In addition, for parameters that do not have human health standards in DEQ-7 (February 2006), the discharge may not cause an increase of a parameter to a level that renders the waters harmful, detrimental or injurious to the beneficial uses listed for Class I ground water [ARM 17.30.1006(1)(c)(ii)].

The Montana Water Quality Act requires that a discharge to state water shall not cause a violation of a water quality standard outside a Department authorized mixing zone. Ground water quality standards for nitrate (as N) apply at the down-gradient mixing zone boundary in the unconfined aquifer. Water quality standards for other parameters that have not been granted a mixing zone apply below the discharge area. The WQBELs have been determined as follows:

A. Nitrate

The TN concentration in the I/P cell effluent is estimated to determine whether the applicable ground water quality standard (10 mg/L) can be met at the end of the mixing zone. A sensitivity analysis estimates the ground water nitrate+nitrite (as N) concentration at the end of the mixing zone that would result from the discharge. This estimate is derived from a dilution calculation according to the mass balance equation:

$$C_2 = \frac{C_3(Q_1 + Q_2) - C_1 Q_1}{Q_2} \qquad \textit{(eqn. 1)}$$

where:
C_1 = Ambient (background) ground water nitrate+nitrite (as N) concentration (mg/L).
C_2 = Allowable nitrate (as N) discharge concentration (mg/L).
C_3 = Ground water concentration limit for nitrate (as N) [from Circular DEQ-7 or other appropriate water quality standard] at the end of the mixing zone
Q_1 = Ground water volume mixing with the discharge (ft^3/day).
Q_2 = Design discharge volume (ft^3/day).

As discussed in Part IV. A., the average background ground water nitrate+nitrite (as N) concentration (C_1 in equation 1) in MW-3 has been 5.05 mg/L since May 2002. The nitrate+nitrite concentrations were significantly lower during the two years prior to May 2002. However, since the nitrate+nitrite concentrations in MW-3 have been consistently elevated for the past two years, the background concentration used for determining the WQBEL will be based on those values. If background groundwater nitrate+nitrite concentrations change in the future the permit effluent limits may need to be modified.

The allowable nitrate concentration (C_3 in equation 1) at the end of the ground water mixing zone is 10 mg/L (DEQ-7 water quality standard).

The design flow (Q_2 in equation 1) is 374,000 gpd (50,000 ft^3/day).

The volume of ground water that will mix with the discharge (Q_1 in equation 1) is estimated using Darcy's equation:

$$Q_1 = K\ I\ A \qquad \textit{(eqn. 2)}$$

Where:
Q_1 = ground water flow volume (ft^3/day)
K = hydraulic conductivity (ft/day)
I = hydraulic gradient (ft/ft)
A = cross-sectional area of flow at the down-gradient boundary of the standard 500-foot mixing zone (ft^2).

Two Q_1 values need to be calculated for the warm-weather and cold-weather mixing zones. For the warm-weather mixing zone (470 feet wide at the source), Q_1 is:

$$Q_1 = (600\ ft/day)(0.0079\ ft/ft)(9{,}143\ ft^2)$$
$$Q_{1(warm)} = 43{,}338\ ft^3/day$$

For the cold-weather mixing zone (660 feet wide at the source), Q_1 is:

$$Q_1 = (600\ ft/day)(0.0079\ ft/ft)(12{,}259\ ft^2)$$
$$Q_{1(cold)} = 58{,}108\ ft^3/day$$

Hydraulic conductivity of the shallow ground water (600 feet/day) is based on a summary of previous aquifer tests performed in this general area (Custer, 1994). The aquifer tests include three that were included in a U.S. Geological Survey report (Hackett, et. al., 1960) and other more recent tests.

As discussed in Part IV. B., the hydraulic gradient is based on an average of eleven quarterly water level monitoring events on wells MW-1, MW-2 and MW-3 between June 2000 and January 2003. The gradient is 0.0079 ft/ft at a direction of N29 ^{o}E.

The area (A) is calculated by the width at the end of the mixing zone times a standard depth in the groundwater of 5 meters (16.4 feet). It is assumed that the entire TN load in the effluent converts to nitrate and enters the ground water.

The effluent concentration necessary to maintain the nitrate concentration at the end of the warm-weather mixing zone at less than 10 mg/L is calculated below using equation 1:

$$C_{2(warm)} = \frac{10\text{ mg/L }(43{,}338\text{ ft}^3/\text{d} + 50{,}000\text{ ft}^3/\text{d}) - [(5.06\text{ mg/L})(43{,}338\text{ ft}^3/\text{d})]}{(50{,}000\text{ ft}^3/\text{day})}$$

$$C_{2(warm)} = 14.3\text{ mg/L}$$

The effluent concentration necessary to maintain the nitrate concentration at the end of the cold-weather mixing zone at less than 10 mg/L is calculated below using equation 1:

$$C_{2(cold)} = \frac{10\text{ mg/L }(58{,}108\text{ ft}^3/\text{d} + 50{,}000\text{ ft}^3/\text{d}) - [(5.06\text{ mg/L})(58{,}108\text{ ft}^3/\text{d})]}{(50{,}000\text{ ft}^3/\text{day})}$$

$$C_{2(cold)} = 15.7\text{ mg/L}$$

The more restrictive value of the two calculations (the warm-weather mixing zone) will be used for the effluent limit. Therefore, the maximum concentration of TN discharged to ground water must not exceed 14.3 mg/L at outfall 001. This effluent limit ensures the nitrate (as N) concentration at the end of the ground water mixing zone will remain at or below the water quality standard of 10 mg/L. As discussed in Part V.B., there is approximately a 16% reduction of TN (due to denitrification) beneath the IP beds. Therefore, to discharge a TN concentration of 14.3 mg/L to the ground water, the WQBEL for outfall 001 is 16% higher than that value, which is 17 mg/L.

B. Fecal Coliform Bacteria

Fecal coliform bacteria monitoring in the ground water is included in this permit because:

- the shallow aquifer is a coarse grained alluvial aquifer with a high hydraulic conductivity (600 ft/day), which will allow relatively rapid transport of fecal coliform if any are able to migrate into the groundwater;
- the IP beds are designed to discharge a significant amount of wastewater (374,000 gpd) at a relatively rapid rate; and

- the potential for additional high-density development in the area near outfall 001.

A virus transport study conducted in western Montana revealed a four log decrease of pathogens when discharged directly into the ground water but the results are site specific and are dependent on the amount of fine soil present at the site (Woessner, 1998).

The permit will require ground water monitoring on the downgradient edge of the IP beds (at MW-2) to insure that the DEQ-7 (February 2006) water quality standard (<1 fecal coliform/100 ml) is not exceeded.

C. Phosphorus

Phosphorus does not have a numeric ground water quality standard. Therefore, there is no WQBEL for phosphorus for Outfall 001.

The WQBELs for Outfall 001 are summarized in Table 6.

Table 6. Water Quality-Based Effluent Limits for Outfall 001

Parameter	Daily Maximum Concentration (1) (mg/L)	90-Day Average Load(1) (pounds per day)
Total Nitrogen as N(2)	17.0(4)	53.0 (3)

(1) See definitions in Part I.A of the permit.
(2) Total Nitrogen (TN) is the sum of nitrate, nitrite and total kjeldahl nitrogen (as N).
(3) This value is determined by using the 90-day average concentration limit and the design flow of outfall 001: Load (lb/d) = flow (gpd) x concentration (mg/L) x 8.34×10^{-6}.
(4) This limit becomes effective if the concentration of nitrate (as N) in monitor well MW-2 exceeds 10 mg/L, or if the effluent flow rate exceeds the design capacity (374,000 gpd) in any single reading.

VII. FINAL PROPOSED EFFLUENT LIMITS

There are no numeric WQBELs for either BOD or TSS. Therefore the final effluent limits will be based on the TBELs.

The concentration TBEL for TN, which is based on the method of wastewater treatment system and the season, is 28.7 mg/L during the warm-weather months (May-October) and 35.9 mg/L during the cold-weather months (November-April). Based on the mass balance calculation, the WQBEL for TN is 17.0 mg/L. The final TN effluent limits will be based on the more restrictive WQBEL.

There is no TBEL or WQBEL for fecal coliform bacteria.

There is no TBEL or WQBEL for phosphorus.

The proposed effluent limitations for Outfall 001 are summarized in Table 7.

Table 7. Numeric Effluent Limits for Outfall 001

Parameter	Concentration (1) (mg/l)			Load(1) (lb/ day)	
	7-Day Average	30-Day Average	Daily Maximum	30-Day Average(2)	90-Day Average(2)
BOD_5 (mg/l)	45	30	NA	93.6	NA
TSS(mg/l)	45	30	NA	93.6	NA
pH (s.u.)	6.0 – 9.0				
Percent Removal (3)	85% BOD_5 and TSS				
Effluent Flow Rate, gpd	374,000 maximum flow				
Total Nitrogen as N(4)	NA	NA	17.0(5)	NA	53.0

(1) See definitions in Part I.A of the permit.
(2) Calculations based on the average values of design flow and concentration for the specified time period. Equation is Load (lb/d) = flow (gpd) x concentration (mg/L) x 8.34×10^{-6}.
(3) The arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15% of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (85% removal).
(4) Total Nitrogen (TN) is the sum of nitrate, nitrite and total kjeldahl nitrogen (as N).
(5) This limit becomes effective if the concentration of nitrate (as N) in monitor well MW-2 exceeds 10 mg/L, or if the effluent flow rate exceeds the design capacity (374,000 gpd) in any single reading.
NA Not Applicable

VIII. MONITORING REQUIREMENTS

A. Effluent Monitoring

Effluent monitoring is essential to ensure the effective treatment of the wastewater discharged from the facility. The effluent limits are established to protect the ground water from a change in water quality that would exceed a water quality standard [ARM 17.30.1006(1)(b)(i)] or cause a change in beneficial use [ARM 17.30.1006(1)(b)(ii)].

At a minimum, upon the effective date of the permit, the constituents in Table 8 shall be monitored at the frequency and with the type of measurement indicated. Samples or measurements shall be representative of the volume and nature of the monitored discharge. The permittee shall submit the location and method of flow monitoring to the Department within 60 days of the effective date of the permit. The measurement method shall be either by recorder or totalizing flow meter; dose counts or pump run-times will not be accepted.

The effluent sampling location shall be from the discharge manhole near the exit from lagoon cell 2 at location “C2” (see Attachment 2b) prior to discharge to lagoon cell #3 and/or the IP beds.

The reporting period for the constituents in Table 8 is quarterly.

Table 8. Parameters Monitored in the Effluent for Outfall 001 (prior to discharge to lagoon cell #3 and/or IP beds)

Parameter(1)	Frequency	Sample Type(2)
Effluent Flow Rate, gpd(3)	Continuous	Continuous
Total Suspended Solids (TSS), mg/L	Quarterly	Composite
Biological Oxygen Demand (BOD_5), mg/L	Quarterly	Composite
Chloride, mg/L	Quarterly	Composite
Fecal Coliform Bacteria, organisms/100 ml	Quarterly	Grab
Total Phosphorus as P(4), mg/L	Quarterly	Composite
Nitrate + Nitrite as N, mg/L	Quarterly	Composite
Ammonia as N, mg/L	Quarterly	Composite
Total Kjeldahl Nitrogen as N, mg/L	Quarterly	Composite
Total Nitrogen(5), mg/L	Quarterly	Calculated
Total Phosphorus, lb/day(6)	Quarterly	Calculated
Total Nitrogen, lb/day(6)	Quarterly	Calculated
Oil & Grease	Semi-annually	Composite
Total Phenols	Semi-annually	Composite
Arsenic, dissolved	Semi-annually	Composite
Cadmium, dissolved	Semi-annually	Composite
Chromium, dissolved	Semi-annually	Composite
Copper, dissolved	Semi-annually	Composite
Lead, dissolved	Semi-annually	Composite
Mercury, dissolved	Semi-annually	Composite
Selenium, dissolved	Semi-annually	Composite
Silver, dissolved	Semi-annually	Composite
Zinc, dissolved	Semi-annually	Composite

(1) Laboratory detection limits must be equal to or less than the required reporting value (RRV) in DEQ-7 (February, 2006) for those parameters where an RRV is specified in DEQ-7.
(2) See definitions in Part I.A of the permit
(3) To be measured by a recorder or totalizing flow meter
(4) EPA Method 365.1 or equivalent.
(5) Total Nitrogen (TN) is the sum of nitrate, nitrite and total kjeldahl nitrogen as N.
(6) See definition of "quarterly average" in Part I.A. of the permit. The calculation used for determining load is: Load (lb/d) = flow (gpd) x concentration (mg/L) x 8.34×10^{-6}.

B. Ground Water Monitoring and Compliance Limits

Ground water monitoring is required for this permit due to the following site-specific conditions:

- the shallow aquifer is a coarse grained alluvial aquifer with a high hydraulic conductivity (600 ft/day), which will allow relatively rapid transport of contaminants that are able to migrate into the groundwater;
- the IP beds are designed to discharge a significant amount of wastewater (374,000 gpd) at a relatively rapid rate; and

- the potential for additional high-density development in the area near outfall 001.

The permittee is required to monitor the ground water on the downgradient edge of the IP beds from existing monitoring well, MW-2 (see Attachment 5). Ground water monitoring of existing monitoring well MW-1 will not be required in the permit because based on past monitoring it would not provide any additional data on the impacts to the groundwater as a result of the discharge from outfall 001.

In addition to the downgradient monitoring well, MW-2, the permit will require a new upgradient monitoring well to replace the existing well MW-3. As discussed in Part IV, the ground water in MW-3 has experienced some significant fluctuations of nitrate and chloride values between 1999 and 2004. The cause of these fluctuations are unknown, there are no obvious surface sources directly upgradient of the well. To minimize the effects of potential off-site sources, the permit will require a new background well, MW-4, be installed on-site within 100 feet of the southwest corner of Outfall 001 (see Attachment 5). Monitoring results from MW-4 will be used for comparison with results from the well within the mixing zone, MW-2, to help determine potential causes of ground water quality fluctuations.

The parameters to be monitored in MW-2 and MW-4 are listed in Table 9. The reporting period for the constituents in Table 9 is quarterly.

Table 9. Ground Water Monitoring Parameters for Monitoring Wells MW-2 and MW-4

Parameter	Frequency	Sample Type(1)
Static Water Level (SWL) (feet below top of casing)	Quarterly	Instantaneous
Fecal Coliform Bacteria, organisms/100 ml	Quarterly	Grab
Nitrate as N, mg/L	Quarterly	Grab
Chloride, mg/L	Quarterly	Grab

(1) See definitions, Part I.A of the permit.

The monitoring of chloride is used as an indicator of wastewater impacts, and will be used to assess the effectiveness of the well location in monitoring ground water impacts when the permit is renewed.

MW-2 is located within the 500-foot long mixing zone for Outfall 001 (see Attachment 5). Typically, the monitoring wells for parameters that are granted a mixing zone (nitrate in this case) are located at the end of the mixing zone, which is the location that the water quality standard must be met. In this case, the mixing zone extends over property not owned by the permittee and the permittee may not be able to obtain access to that property. Therefore, existing well MW-2 will be used as the ground water compliance monitoring location. The ground water compliance limits for MW-2 are listed in Table 10.

Table 10. Ground Water Compliance Limits for Monitoring Well MW-2

Parameter	Instantaneous Maximum[1]
Fecal Coliform Bacteria, organisms/100 ml	Less than 1
Nitrate as N, mg/L	10

1. See definitions, Part I.A of the permit.

If monitoring results from MW-2 demonstrates that the ground water quality standard for fecal coliform bacteria or nitrate (as N) in the receiving ground water are exceeded as a result of the permitted discharge, the requirements of the Special Conditions in Part V, Section A. of the permit will be implemented.

If a ground water compliance limit is exceeded at MW-2 the special conditions include the option of installing an additional monitoring well (MW-5) at the end of the 500-foot mixing zone if the permittee is able to gain access to that land for the purposes of constructing and monitoring the wells. If constructed, MW-5 shall serve as the compliance monitoring point for nitrate (as N) at the end of the standard 500-foot ground water mixing zone. MW-5 shall be screened approximately from the top of the high ground water table to 15 feet below the low water table. If constructed, the parameters to be monitored in MW-5 will be the same as those listed in Table 9. If constructed, the compliance limits for MW-5 will be the same as those listed in Table 10.

IX. NONDEGRADATION SIGNIFICANCE DETERMINATION

The Department has determined that this discharge does not constitute a new source for the purpose of the Montana Nondegradation Policy [75-5-303, MCA; ARM 17.30.702(18)] because this facility was originally approved by the Department prior to April 29, 1993.

X. INFORMATION SOURCES

ARM Title 17, Chapter 30, Sub-chapter 5 - Mixing Zones in Surface and Ground Water.

ARM Title 17, Chapter 30, Sub-chapter 10 - Montana Ground Water Pollution Control System (MGWPCS) Standards

ARM Title 17, Chapter 30, Sub-chapter 7 - Nondegradation of Water Quality.

Bauman, B.J. and W.M. Schafer, (1984), Estimating ground-water quality impacts from on-site sewage treatment systems, proceedings of the 4th National Symposium on Individual and Small Community Sewage Systems, New Orleans, ASAE.

Circular DEQ-7 – Montana Numeric Water Quality Standards, February 2006.

Custer, S.G.. 1994. Hydrology for the Belgrade Waste Water Facility Plan, 23 pp.

Hackett, O.M., Visher, F.N., McMurtrey, R.G. and Steinhulber, W.W., 1960. Geology and Ground-Water Resources of the Gallatin Valley, Gallatin County, Montana. U.S. Geological Survey Water Supply Paper 1482, 282 p.

Harkin, John M., Charles J. Fitzgerald, Colin P. Duffy, and David G. Kroll. 1979. Evaluation of Mound Systems for Purification of Septic Tank Effluent. University of Wisconsin, Madison. Tech. Report WIS WRC 79-05.

USEPA, Office of Water 4304, Drinking Water Regulations and Health Advisories, EPA 822-B-96-002, October 1996.

USEPA, Manual: Guidelines for Water Reuse, EPA/625/R-92/004, September 1992.

USEPA, Onsite Wastewater Treatment Systems Manual, February 2002.

Woessner, Wm. W., Thomas, Troy, Ball, Pat and DeBorde, Dan C., (April 1998), Virus Transport in the Capture Zone of a Well Penetrating a High Hydraulic Conductivity Aquifer Containing a Preferential Flow Zone: Challenges to Natural Disinfection. University of Montana, Missoula, Montana.

Prepared by: Department of Environmental Quality **Date :** February 2006